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February 27, 2009

Mr. C. Wayne Ives, P.G.
Hydrogeologist
Watershed Management Bureau-NHDES
P.O. Box 95
29 Hazen Drive
Concord, NH 03302-0095

Re: Draft Lamprey River Proposed Protected Instream Flow Report

Dear Wayne,

Please find enclosed our preliminary comments regarding the Draft Lamprey River Proposed Protected Instream Flow Report dated December 9, 2008. Emery & Garrett Groundwater, Inc. (EGGI) serves as the professional groundwater consultant for numerous communities that derive their water from the Lamprey River Watershed (e.g., Durham, Newmarket, Raymond, etc.). Each of these communities has expressed concerns regarding this study and report and they will be submitting a separate letter of comments expressing their concerns.

This letter will serve as a very *brief* summary of several technical questions/comments that we believe requires clarification or a full explanation. Those individuals who have contributed to these comments include:

James M. Emery, President, PG
Peter Garrett, Senior Vice President, Ph.D., PG
John Brooks, Senior Project Manager, Ph.D., PG
Ken Hardcastle, Senior Project Manager, Ph.D., PG
Dan Tinkham, Senior Hydrogeologist, M.S., PG

We appreciate the complexity and the impressive level of effort that has gone into this investigation and we are grateful for the opportunity to provide comments. We are hopeful that you will consider our comments in the context they are presented, which is to help assess the validity and accuracy of using this approach in establishing Protected Instream Flows for the Lamprey River.

Our comments are as follows:

1. Water Uses Upgradient of the Designated Section of the Lamprey River

Water withdrawals and dam operations upgradient of the designated portion of the Lamprey River were included in the assessment of the naturalized flow (EGGI Figures 1 and 2).

A) The only registered water users and public supply wells mentioned in the Report are those of Durham/UNH and Newmarket. Why is there no discussion of other water resources upgradient of the designated portion of the Lamprey River? Please provide a list of the water supply wells and dams that were included in the evaluation of the naturalized flow.

B) What is the total amount of groundwater withdrawals removed from the measured flow data to determine the naturalized flow?

C) Have all towns, water supplies, dam operators, and environmental groups upgradient of the designated section been notified of the Lamprey River Instream Flow study, and specifically notified that the results of the study could potentially impact the use of water resources in their communities, from their wells, or within their lakes?

2. Poor Labeling of Hydrographs and Inconsistent Use of Terminology

Appendix A describes a process of creating naturalized flow by removing the impacts of water withdrawals and dam operations from the measured river flow. *However, it is not clear throughout the document when analyses are performed using naturalized flow vs. measured flow.* For example, the graphs in Figures 3 and 9 display mean daily flows[1], but there is no indication of whether this is for naturalized or measured flow. (Is this the measured flow for the entire period of record or is it a composite data set of measured flow before 1955 and corrected data post 1955?) *Please provide an explanation.*

Under the discussion of hydrographs, several terms were used to describe flow data, including Historic Data, Naturalized Flow, Untransformed Representative Hydrographs, Representative Hydrographs, Selected Hydrographs, Simulated Hydrographs, and Target Hydrographs. *These terms are extremely confusing; please provide an explanation.*

There seems to be multiple places in Part 2, Section II of the Report where the meaning of the term "met" or "meets" is difficult/impossible to interpret. In some contexts, it appears as though the term "meets the PISF" refers to the instance when a flow value is higher than the PISF and that particular flow is allowable or acceptable. In other cases, it appears that the same term implies that a flow has decreased to the point where it falls below the PISF and it is no longer allowable or acceptable. The document needs to be very clear about this term, so that the tables in Part 2, Section II can be interpreted correctly and consistently. *Please provide an explanation.*

[1] Or is this the mean of mean daily flows? They are differently represented on Figures 3 and 9.

All graphs, tables, and supporting calculations need to be reviewed and clearly and consistently labeled.

3. Potential Errors in PISF Analyses

The foundation of the instream flow values is, in theory, based on determining and maintaining natural streamflow conditions. This includes the evaluation of habitats, fish populations, vegetation, water flows, etc. The evaluation of each of these parameters (dependent or independent) has many errors and unknowns associated with them. Yet there are no error assessments or sensitivity analyses for any of these parameters and their associated potential impacts on the accuracy of this model.

For example, the calculations of the PISFs are dependent upon which flow data set is used (naturalized or measured). Based on the description in Appendix A13, the naturalized flow will be greater in the Spring and lower in the Fall than the measured flow. Therefore, the PISFs would be higher for the spring and lower in the Fall if the naturalized flows are used for the analysis than if the measured flows are used. This will result in a higher number of actual flows that are lower than the PISF for the Spring seasons. This will also require the implementation of more frequent watershed management techniques … such as reducing the water withdrawals or initiating dam releases.

Assuming that the naturalized flow was used in the PISF analyses, then it is important to understand the error associated with the creation of the naturalized flow time series used in the analyses. Unfortunately, the report does not present any assessment of error in the calculation of the naturalized flow. By using the mean daily flow hydrograph presented in the report (Figures 3 and 9), it can be seen that the 20.80 to 33.00 cfs correction used in the February-May period is approximately 3 to 10% of the total flow and the 29.29 cfs correction used in the October-December period is approximately 10 to 30% of the flow (this range represents percentages of the range of flows in each season). *These are very significant adjustments to the measured flow and would result in potentially very significant errors in the hydrograph corrections, and subsequently designated PISFs. For example, the Fall corrections of 29.29 cfs are approximately 75% of the critical flow for this time period (i.e. 40 cfs). The fact that the corrections made to the measured data are nearly equal to the critical flow is very troubling.*

In addition, it is necessary to show representative illustrations of how the corrections to the measured flow impacted the hydrographs (i.e., during wet and dry three-year periods). It would also be useful to have some information about the relationship between the magnitude of the corrections and the total flow. What error is associated with this process? This information must be presented to understand whether the corrected hydrographs, and resulting PISFs are reasonable and scientifically credible.

We request that you provide a full explanation of what the overall potential errors might be in your analyses and how they would impact the accuracy of your designation of PISF values.

4. Seasonal Adjustments Made to the Hydrographs

Three seasonal adjustments were made to the hydrographs to compensate for how the post 1955 operation of the Dolloff Dam impacts flow (Appendix A13). These include a 20.80 cfs adjustment for February 21-March 29, a 33 cfs adjustment for March 30 to May 5, and a 29.29 adjustment for October 12 to December 19. Appendix A13 indicates that these correction periods were converted into a daily time series and then added/subtracted to the measured data to create a naturalized flow hydrograph. However, there is no description of how the conversion to a time series was completed. *Was data smoothing used? If so, how was this accomplished and/or applied? How does this smoothing impact the accuracy of the hydrographs for the time periods (Spring and Fall) that are between the correction periods (Summer and Winter)? Please explain (or provide the evidence for) why these corrections do not adversely alter the accuracy of the flow duration curves and, subsequently, the selected PISFs.*

5. The "Naturalized Flow" Does Not Reflect Land Use Changes that have Occurred in the Lamprey River Watershed Over the Past Several Decades, which Impairs the Accuracy of the Selected PISFs

Although there is some discussion regarding the attempt to make adjustments to the measured daily flow values of the Lamprey River due to water withdrawals and known storage changes in Lake Pawtuckaway, the so-called "naturalized flow" does not reflect the myriad number of land use changes that have occurred in the Lamprey River Watershed over the past several decades. The dramatic changes in land use within the Lamprey River Watershed have gradually caused significant increases in the amount of impermeable surface area. Each land use change in and of itself has created an imperceptible change in the flow duration curve of the Lamprey River, but the cumulative effect of thousands of small changes has undoubtedly changed the character of the flow duration curve over many decades. The cumulative impact of land use changes may well be more significant to the correction of the flow data than the known withdrawals or changes in storage in Lake Pawtuckaway. Therefore, the flow duration curve for today's Lamprey River will differ from that over the period of record. This fact raises substantial uncertainty regarding the ability to predict truly naturalized flow.

If the increase in impermeable surface area creates longer-duration and lower magnitude low-flow events, then today's measurements of low flow are much more likely to be less than the PISFs, which are based upon flow statistics from a relatively long period of record. Therefore, any management scheme for the River that hopes to re-create "pre-colonial" flow conditions will have to overcome the effect of all the land use changes that have occurred in the entire watershed. *We do not consider this as being realistic and request that a full explanation be made that addresses these significant sources of inaccuracy in this analyses.*

6. Common Flows Exceed Mean Daily Flows – Why?

Based upon EGGI's Figure 3 (attached)[2] presented herein, we ask the question … *How can Common flows, as defined in the report, exceed the mean of daily mean flows during the low flow conditions of summer? This would seem to invalidate the analyses. Please provide a full explanation.*

7. Comparison of PISFs to historic stream flow

Part 2 – Section II of the Report presents a number of tables showing the number of days (and percent of days) that a particular PISF is met (or exceeded) for representative periods of the hydrograph data. For example, these periods include 1) the Last Five Years of record; 2) Wet Three Years; 3) Average Three Years; and 4) Dry Three Years. Several questions are raised about the analyses from the data presented.

A) *What PISFs are used in these evaluations? Common, Critical, Rare, or all?*

B) Some of the PISFs are met or exceeded nearly all of the time (e.g. Deep and Shallow Marsh or Blandings Turtle/Spotted Turtle) and other PISFs are rarely met or exceeded (e.g. Low Floodplain Forest-Growing Season or High Floodplain Forest and Oxbow/Backwater). It seems reasonable to expect that the amount of time a PISF is met or exceeded during the various bioperiods would be relatively similar. *Why is this not the case? Of what value is it to have PISF that is exceeded by river flows nearly 100% of the time, or almost never, regardless of the time period or seasonal precipitation?*

C) Table 44 – All of the bioperiods, except for GRAF Spawning, have longer Catastrophic Durations than Allowable Durations (for each level of flow). *Why is the Catastrophic Duration shorter than the Allowable Duration for the GRAF Spawning critical flow?*

D) Tables 45-48 show the number of times in the hydrograph record that a PISF were not met (i.e. flow was below the PISF). However, one can not tell how many times or how long a water management plan would have been required for each scenario shown on the Tables. This information would serve as important background information for the Water Management Technical Committee, and would also give some perspective on whether the PISFs are set too high to be reasonably met in the future through watershed management. *Please present a table showing the number of times a Management Plan would be required and the duration of the Plan for each scenario presented.*

[2] EGGI has superimposed the PISFs on Figure 3 for the common and critical periods onto Figure 9 that was presented in the Proposed Protective Instream Flow Report.

8. How Does MesoHABSIM Compare to Other Methods?

The Lamprey River Instream Flow Study is a pilot program to evaluate methods for restoring the Lamprey River to natural conditions. However, there are no discussions of how the MesoHABSIM method compares to other alternatives in effectiveness (except for simply mentioning another method at the beginning of the report). *Why was the MesoHABSIM model selected?* It is important to know where this method has been applied previously, and whether it has been successful in restoring other rivers/streams to the desired conditions. It would also be useful to compare this complicated method to other simpler methods based on hydrograph analyses. For example, how do the PISFs defined compare to seasonal Q80 values of stream flow.[3]

Please provide evidence as to why the MesoHABSIM method is considered accurate and more reliable than other methods. Has the MesoHABSIM method been vetted by other industry experts?

9. Natural Fish Species Versus Target Fish Species

The target fish communities for the Lamprey River are derived from "near-pristine rivers with similar characteristics to the Lamprey." We see no description of 1) which rivers were used as proxies for the Lamprey River; 2) a description of how these rivers are considered similar to the Lamprey River; 3) a discussion of how the fish species in each proxy river have been determined and 4) if the fish species in each proxy river are natural (i.e., there was no introduction of fish species by humans). All this information would be needed/helpful so that readers can assess if the rivers are similar…and if the target fish communities are reasonable.

Furthermore, did these investigations perform historical research to find out what species were present in the Lamprey under natural, pre-human impacts? It is entirely reasonable to expect that the "pre-colonial" Lamprey River (as referred to in the report) was not an exact physical replica of today's river. For example: 1) there may have been differences in historical stream flow and precipitation; 2) the morphology of the river was likely different due to meandering and changes in deposition and erosion through the years; 3) there may have been more beaver dams and impoundments behind the dams, etc. (Such things would have had water flow and chemistry impacts[4] on the habitats and biota of the river … and would potentially result in natural fish species that were not the same as the target fish communities used in this study.)

Please address the questions above and provide evidence that the target fish community originally selected is an appropriate starting point for this Instream Flow Analyses.

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[3] Based on a quick analysis by EGGI, and statistical data provided by the NHDES, it appears that the seasonal Q80 values are similar to the PISFs defined for the various seasons (certainly within the error of the Instream Flow and NHDES statistical analyses). The largest misfit was in the Fall PISF and Q80 values. As noted above, the Fall season is actually where the corrections to the hydrographs were the largest relative to the measured flow.

[4] For example, beaver and human dams have two related effects on water quality that are somewhat independent of flow, namely that the water tends to be warmer behind a dam and also lower in dissolved oxygen. Water temperature and dissolved oxygen concentrations are likely to have a greater impact on fish species than what was considered in this Report.

10. Lack of Protection for Public Water Supplies

There is a distinct lack of reference and/or guidance in this Report that serves to protect existing and/or future public water supplies that derive their drinking water from the Lamprey River Watershed. Public water sources must be considered as an Instream Public Use. RSA 483 defines flow-dependent entities as fish, riparian wildlife, vegetation, and human uses. The use of water for public water supply from the Lamprey River Watershed within the designated reach (and outside of this specific designated reach) is all flow-dependent and therefore flow must be maintained to meet both existing and future water supply needs.

Please explain why the protection of public water supplies is not included as part of this Report.

These comments reflect only a small number of our questions, but for the sake of reasonableness we have limited this to just those presented above. We remain concerned about the methods used and the subsequent consequences of implementing the suggested PISF values as the basis for establishing a Management Plan. Furthermore, we have concerns about the resultant possible impacts to communities that depend upon the Lamprey River Watershed for *existing and future* public and private water supplies. Lastly, we remain concerned about the limited amount of time that has been set for establishing a Management Plan (October 1, 2009). We believe that this date is premature given that this Report has not yet been completed and that sufficient consensus has not been secured to provide confidence to the watershed community as a whole that these proposed Instream Flow Rates are scientifically defensible.

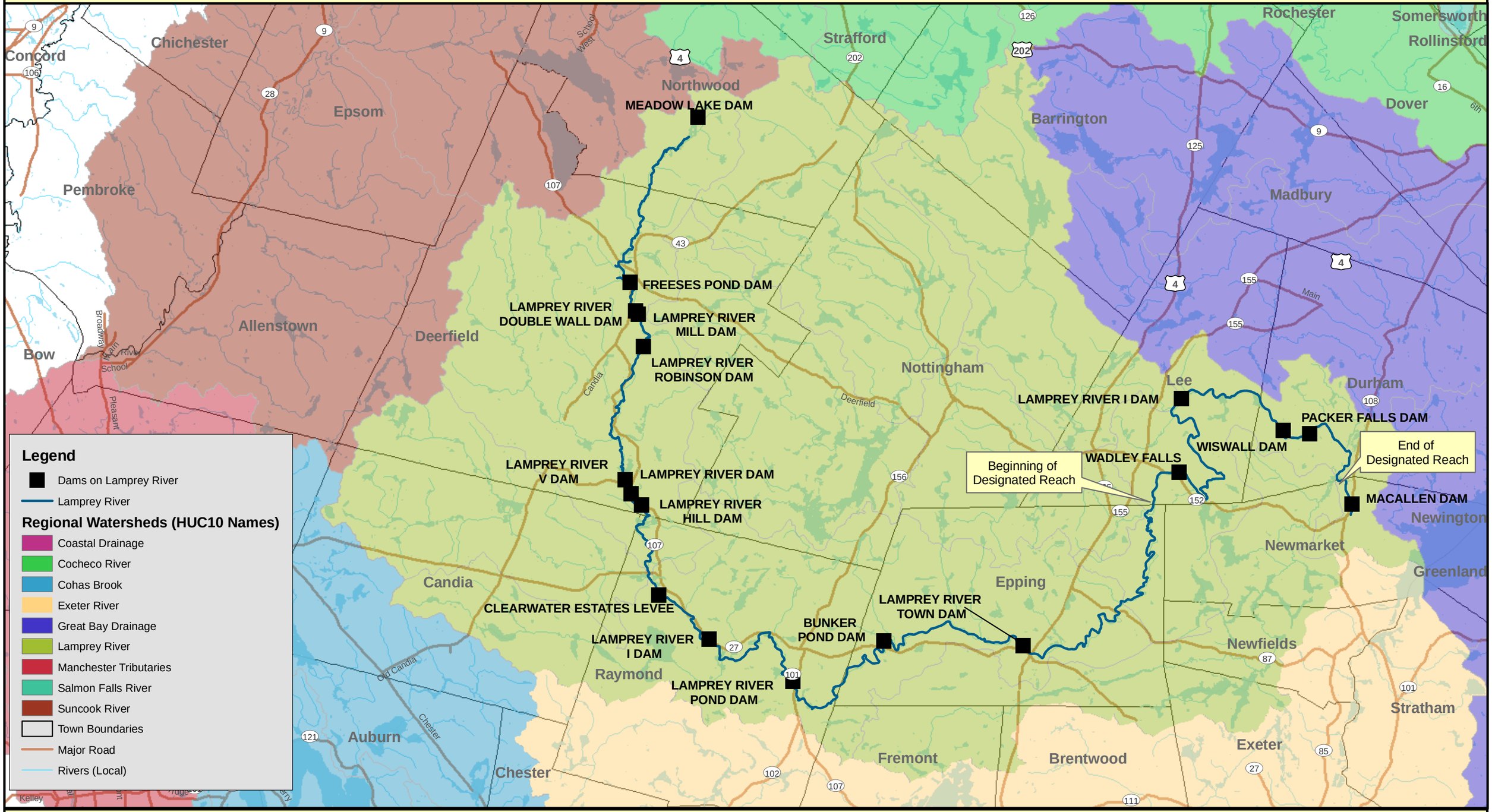
Please accept these comments in a productive and positive manner. Our intent is to help the process of formally developing a protective strategy for New Hampshire rivers. We appreciate the very difficult challenge that is presented to the State and we are supportive of the overall intent of this project.

We look forward to further discussion regarding these matters and to continued productive dialogue regarding this Report and subsequent comments.

Best regards,

James M. Emery, PG	Peter Garrett, Ph.D., PG	John Brooks, Ph.D., PG	Dan Tinkham, MS, PG
President	Senior Vice President	Senior Project Manager	Senior Hydrogeologist

Regional Watersheds, and Dams on the Lamprey River
Lamprey River Proposed Protected Instream Flow Report



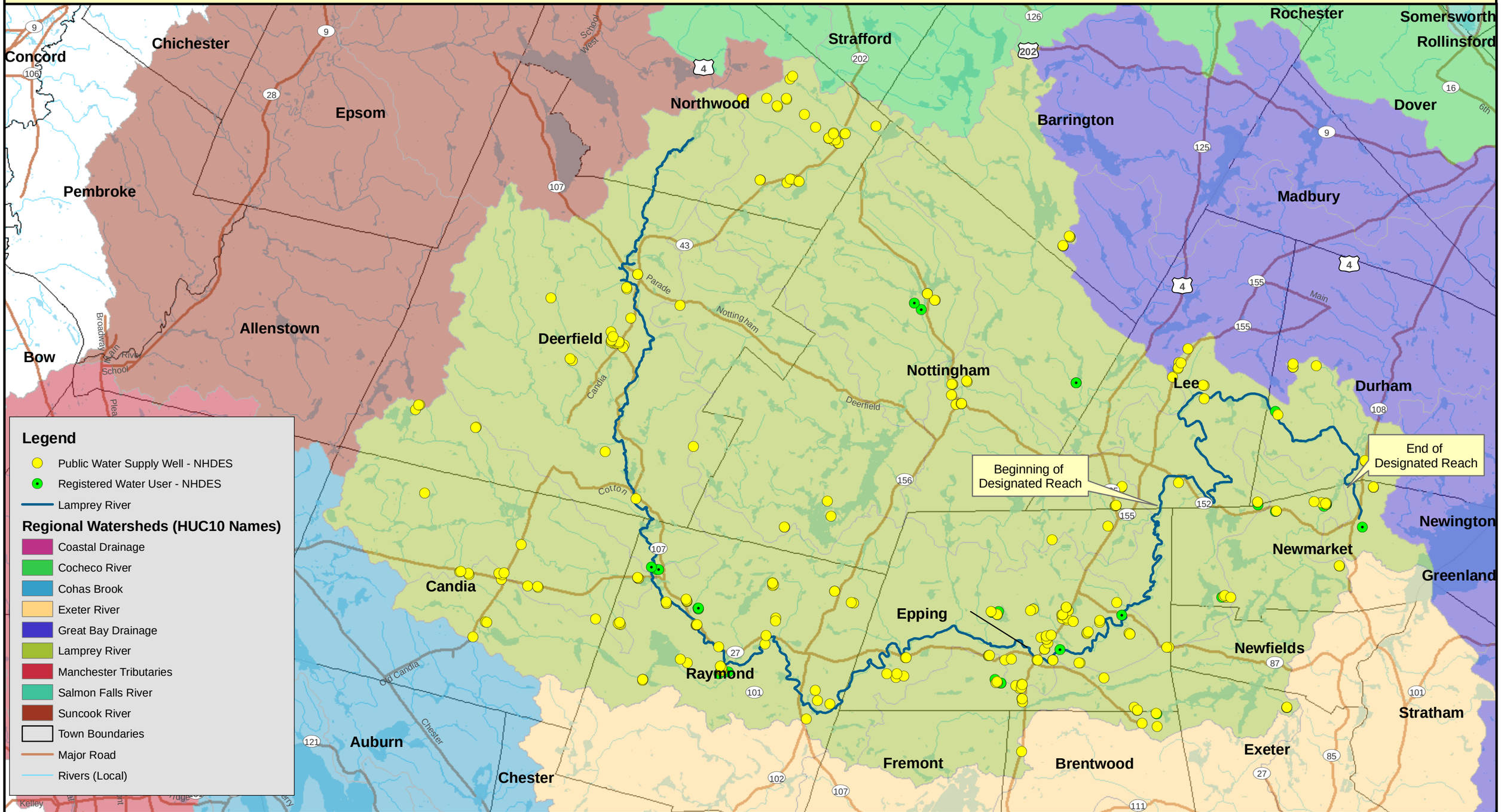
Scale is 1:120,000

1 inch equals 10,000 feet

FIGURE 1

Emery & Garrett Groundwater, Inc.

Regional Watersheds, Public Water Supply Wells, and Registered Water Users within the Lamprey River Watershed
Lamprey River Proposed Protected Instream Flow Report



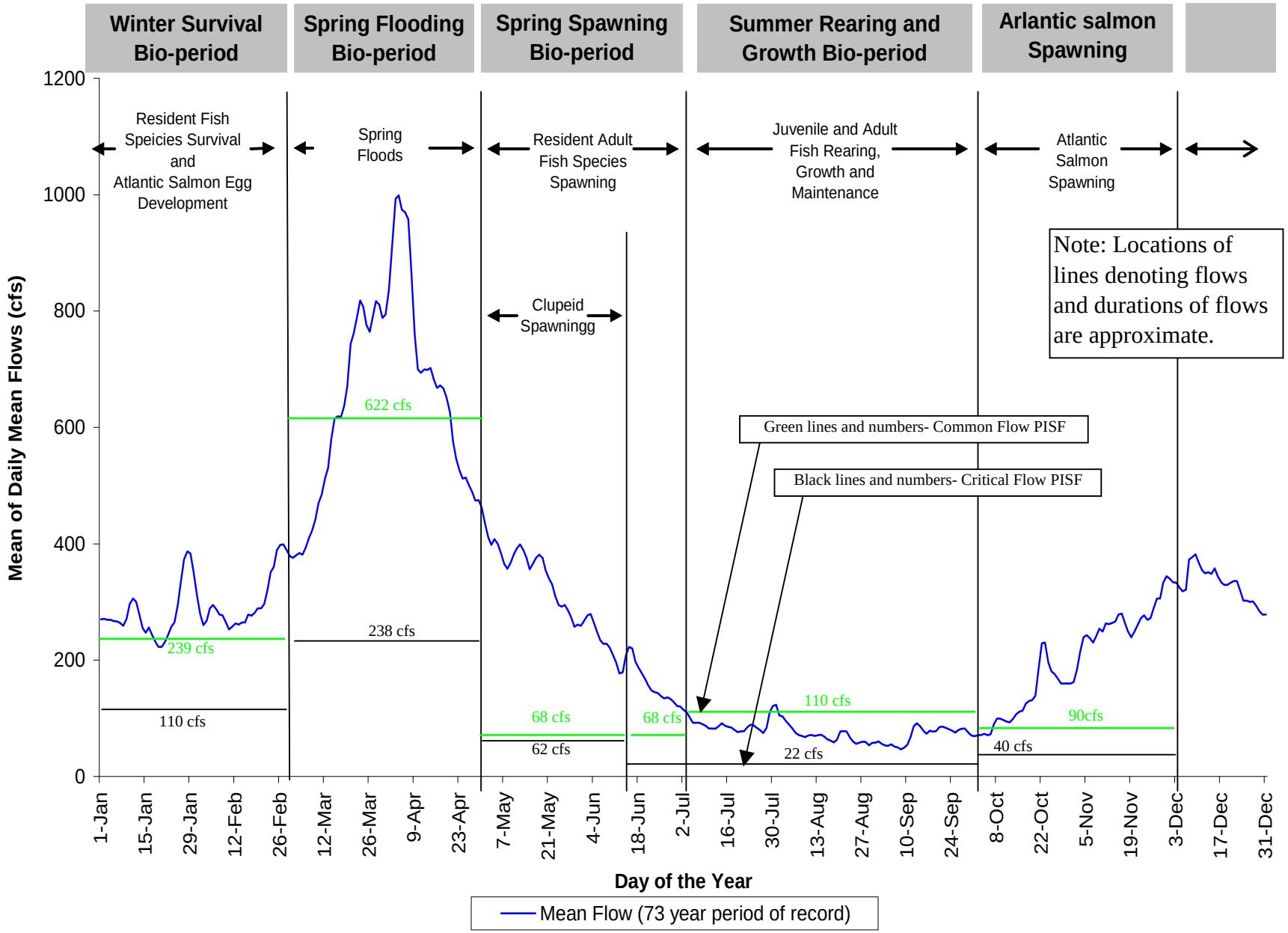
Scale is 1:120,000

1 inch equals 10,000 feet

FIGURE 2

Emery & Garrett Groundwater, Inc.

Figure 3 - Proposed PISF Common and Critical Flows Superimposed on Lamprey River Flow Data



Data sources: PISF Values: Table 44 in Draft Lamprey River Proposed Protected Instream Flow Report.
Hydrograph of Flow: Figure 9 in Draft Lamprey River Proposed Protected Instream Flow Report.

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